

XIV.—*Researches on the Development of the Myriapoda.*

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THE male and female sexual organs in the different genera of the Chilognatha exhibit anatomical peculiarities of which it is difficult to give a succinct account. In all the genera observed by M. Fabre (*Polydesmus*, *Iulus*, *Craspedosoma*, *Glomeris*, *Pollyxenus*) the vulvæ open at the base of the second pair of legs, or between this pair and the third; the orifices of the male organs also occur in the vicinity of the second pair of feet, or at their base. In *Pollyxenus* alone, the spermagenous canals open into two enormous penes, longer than the legs and of a greater diameter than the largest joint of these.

Fecundation takes place in the usual way in *Glomeris* and *Pollyxenus*, by the contact of the male and female organs. On the contrary, it is effected in a very singular manner in the *Polydesmi* and *Iuli*. The male possesses a copulative organ, which in *Polydesmus* is formed at the expense of the first pair of feet of the seventh segment. No communication exists between the spermagenous gland and this apparatus. The male seizes the female with his jaws at the back of the neck, then turns her over, and applies his belly to hers. In this position he passes her a little in front; his mouth is applied to the back of the neck of the female, whilst the latter seizes the throat of the male with her jaws. The copulative apparatus is then placed in front of the vulvæ, which receive it. The copulation lasts about a quarter of an hour. The male soon afterwards sets out in search of another female, and the female admits the advances of another male. By attentively observing a male just after he had quitted a first female, M. Fabre saw him elevate the anterior part of his body, and bending it into the form of an S, bring together the second and seventh segments, that is to say, bring his genital apertures in contact with his copulative apparatus. This manoeuvre, which exactly resembles what takes place in the *Araneida* and *Libellula*, is repeated after each copulation, and it is only after its accomplishment that the male begins his search for another female.

The Chilognatha present considerable differences as regards their development. M. Fabre has been unable to observe the eggs of *Polydesmus complanatus*, but he has found young not more than  $\frac{3}{4}$  mill. in length, and furnished with only three pairs of feet. Each pair of feet was supported upon a different segment, and these legs corresponded with those which, in the adult, are also placed singly upon the first, third and fourth

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segments, both in the male and female. With the progress of development the animal gradually acquires a greater number of segments and feet. The author has followed this progress up to the eighth stage, when the animal has acquired a length of 20 mill., and possesses twenty segments, not including the head; at this period we find thirty pairs of feet in the male and thirty-one in the female; and it is only then that the copulative organs make their appearance. From his observations he derives the following laws:—1. Each new segment appears between the anal and penultimate segments. 2. All the apodal segments in one stage become pedigerous in the next.

Some authors have asserted that the *Iuli* are produced in an apodal state, others that they are born hexapod. M. Fabre has been able to study the eggs of his *I. aterrimus*. Escaping from these he saw a singular body entirely destitute of any appendicular organs, and not presenting the least resemblance in form to the animal from which it was produced. This, which the author calls the *pupoid body* (*corps pupoïde*), is reniform, deeply excavated beneath, convex above, large and rounded at one of its extremities, a little narrowed and conical at the other; its surface is smooth, shining, and of a pure white; it exhibits no movements, even when pricked with a needle. Five days after its exclusion distinct traces of segmentation are seen in this body, and in the thickness of the inflated end the head begins to be perceptible, folded down upon the abdomen. Seven or eight days afterwards, it splits, and the young animal makes its appearance, with the characters attributed by De Geer and Gervais to the *Iulus* at the moment of its birth.

This young *Iulus*, when just excluded, is  $1\frac{1}{2}$  mill. in length; it is completely white, formed of seven segments, not including the head, and furnished with three pairs of feet, which correspond with the first three pairs of the adult; the antennæ are composed of four joints. In proportion as the development takes place, the eyes, which at first were only one on each side, increase rapidly in number, and the older parts of the body acquire a deeper colour. The *Iulus aterrimus* is not completely adult and fit for reproduction before the end of two years; and the life of these animals must apparently be pretty long. M. Fabre has kept adults in captivity for two years.

In the Chilopoda, the ovigenous and spermagenous organs, although complicated, present no remarkable anatomical arrangement. This is not the case with their products, which, in *Scolopendra*, *Cryptops* and *Geophilus*, are enclosed in capsules which M. Fabre thinks he may compare with the spermatophora of the Cephalopoda and of some Crustacea. In *Scolopendra* and *Cryptops* the spermatophora are formed in the most inflated portion

of the seminal canal (*canal vecteur du sperme*); their number is small, as there are usually less than seven of them. They are reniform; their external envelope is very thick, transparent and elastic; the internal envelope, which is very fine and loose, protrudes, in the form of a dull white nipple, through an orifice of the first envelope. In water this nipple becomes inflated, projects more and more, and at last bursts and gives issue to bundles of spermatozoids.

In the *Geophili* "several of the spermatozoids are rolled together in a circular form, and superpose their different spiral turns so as to form a ring, or rather a short hollow cylinder of rolled cords. Each cylinder is then clothed with a protective coat formed of hyaline particles, slightly agglutinated. At the least contact this fugacious envelope breaks up into light flakes." No one has yet succeeded in seeing the copulation of the Chilopoda. M. Fabre has been no more fortunate in this respect than his predecessors, but he has observed some exceedingly curious facts which may explain the mode of fecundation in these animals. He says: "At the end of September, in examining some specimens of *Geophilus convolvens*, Fabre, which I had kept for some time in captivity, I observed in the passages formed by these animals in the mould which served for their abode, some very small nets, formed of arachnoid filaments, arranged at a great distance apart. Their woof was composed of a small number of threads stretched across from wall to wall of the passage, and irregularly crossed. Other similar nets appeared out of the mould, stretched between some stalks of moss with which I had completed the filling of the bottle. At the centre of each, far from contact with any solid body, was suspended a white spherical globule, of the size of a pin's head, which I took at first for an egg. Having detached one of these nets, I examined the globule with the microscope: its delicate envelope burst with the first contact. What was my astonishment at recognizing in this globule a little drop of semen, with its cylinders of spermatozoids in full gyration! Several others were collected, and the results were the same. Inexplicable as this exceptional case was, doubt was impossible: I had certainly the semen of the *Geophilus* before me. In two or three days these first globules had disappeared, either drying, or being destroyed by *Acari*, which appeared to be very fond of them. But new nets were already spread with their drop in the centre, and this continued for about six weeks; so that notwithstanding their rapid destruction, there were always five or six of them in the bottle. I observed the last on the 12th of November."

The *Geophili*, and probably also the other Chilopoda, consequently deposit their spermatophora upon an arachnoid net-

work. But what becomes of them? and how do they arrive at the seminal receptacles of the females? Of this we still know nothing, and it is difficult to form any probable supposition; observation alone can settle the question.

M. Fabre has observed the phases of development in several genera of Chilopoda. *Lithobius forcipatus* is born with ten segments, seven pairs of feet, seven joints in the antennæ, and two ocelli. Two months afterwards, it has acquired its seventeen segments, its fifteen pairs of feet, twenty-six joints in its antennæ, and six ocelli on each side.

He has found the young of *Scutigera araneoïdes* furnished with only seven pairs of feet, and in all probability in the first stage of their development. This species not only presents an increase in the number of segments, legs, ocelli, and joints of the antennæ, but also in that of the joints of the tarsi. What is most singular in this development is, that the segments which bear the first seven pairs of feet, and which exist at the moment of birth, form the half of the body which contains the organs of the senses and the essential parts of the digestive apparatus; whilst the other half, which lodges the reproductive apparatus, is developed subsequently. It appears therefore that this anterior part represents the *larva*, which only manifests the life of the *individual*, and the posterior part the *perfect insect*, in which resides the life of the *species*. This distinction appears the more evident, as the dorsal shield of the median region is the largest of all, and differs so much from the others, that Linnæus called it the *elytron*: it covers three pairs of feet, of which the first two belong to the young animal at the time of its exclusion, and the third to the part of the body produced by gemmation. It thus, as M. Fabre says, marks the separation of the anterior portion of ovular origin, from the posterior portion of gemmary origin. M. Fabre from this compares the development of the *Scutigera* with the facts observed by Milne-Edwards and Quatrefages in *Syllis* and the *Myrianides*.

The development of *Cryptops* is especially interesting, because the parts of the mouth are deficient in the young. With the microscope nothing is seen but a rounded aperture, situated at the extremity of the head, and fringed at the margins. It is also to be observed, that as many as twenty-eight and twenty-nine joints are found in the antennæ of *Cryptops Savignyi*, which afterwards have only seventeen: the original number must diminish with age, either by amalgamation or by the casting of some of the joints.